

BROCADE MLX SERIES ROUTERS



CARRIER-CLASS ROUTING

Multiservice IP/MPLS Routers

HIGHLIGHTS

- Scalable multiservice IP/MPLS Carrier Ethernet routers in 4-, 8-, 16-, and 32-slot options
- Fully distributed, non-blocking architecture with up to 15.36 Tbps fabric capacity
- 1536 1 GbE, 256 10 GbE, and 32 100 GbE wire-speed ports in a single router
- Wire-speed IPv4, IPv6, and MPLS forwarding performance with 1 million FIB entries
- High-availability design with redundant management modules, switch fabrics, power supplies, and fans; hitless failover; hitless software upgrades; and non-stop routing
- Ideal for a wide range of advanced applications in service provider backbones, Metropolitan Area Networks (MANs), Content Service Providers (CSPs), data centers, and distributed enterprises

The Brocade One™ strategy helps simplify networking infrastructures through innovative technologies and solutions. The Brocade MLX Series supports this strategy by enabling higher network performance and scalability with the best price/performance, transforming networks and business models with new, high-value cloud-based services.

The way organizations communicate and conduct business has changed dramatically in the past decade. Services such as high-definition video streaming, cloud services, and anytime/anywhere connectivity not only consume an enormous amount of network capacity, but also create a greater degree of complexity for network operations. As a result, today's network planners are seeking solutions that provide the right mix of scalability, performance, operational simplicity, and cost-effectiveness.

The Brocade® MLX® Series of high-performance routers, which includes existing Brocade MLX Routers and new Brocade MLXe Core Routers, is designed to meet these requirements and many others. The Brocade MLXe routers provide several enhancements to the product family, including rear exhaust for all chassis, timing capabilities for future applications, and higher slot capacity. They also support existing Brocade NetIron® XMR management and line modules, providing additional scaling capabilities.

Built with a state-of-the-art, sixth-generation, network processor-based architecture and terabit-scale switch fabrics, the Brocade MLX Series provides a rich set of high-performance IPv4, IPv6, and Multiprotocol Label Switching (MPLS) capabilities as well as advanced Layer 2 switching capabilities. As a result, these routers address the diverse needs in environments that include service provider backbones, Metro Ethernet networks, transit/wholesale networks, Internet Service Providers (ISPs), Content Delivery Networks (CDNs), Internet Exchange Points (IXPs), data centers, and distributed enterprises.



BROCADE

SCALABILITY WITHOUT COMPROMISING PERFORMANCE

The Brocade MLX Series is highly optimized for IP Ethernet deployments, providing symmetric scaling with chassis options that include 4-, 8-, 16-, and 32-slot systems. These routers offer industry-leading wire-speed port capacity without compromising the performance of advanced capabilities such as IPv6, MPLS, and MPLS Virtual Private Networks (VPNs). For example, the Brocade MLXe-32 delivers data forwarding performance in excess of 6 Tbps today and scales to 15.36 Tbps, enough capacity to future-proof networks for years to come.

However, true router scalability is measured not only in terms of packet forwarding performance, but also in the scalability of the hardware forwarding tables and maturity of the control plane. The Brocade MLX Series line modules offer service providers a scale-as-you-grow model with hardware Forwarding Information Base (FIB) capacity options of 256,000 IPv4, 512,000 IPv4, and 1 million IPv4 entries. For MPLS applications, these line modules support the entire 1 million label range.

In addition, the robust control plane has been proven in thousands of mission-critical deployments around the globe. For data center environments, the Brocade MLX Series provides high-density 1 Gigabit Ethernet (GbE) and 10 GbE line modules that are purpose-built to enable greater consolidation and collapse network layers. Because all the routers utilize identical software, they can provide a unified solution from the service provider core to the data center core.

DESIGNED FOR NON-STOP NETWORKING

Designed to enable reliable converged infrastructures and support mission-critical applications, the Brocade MLX Series features advanced redundant switch fabric architecture for very high availability. The architecture helps ensure that the system continues to operate at peak performance even in the case of a switch fabric card failure. In the highly unlikely case of additional fabric failures, the advanced architecture allows the system to continue operating in a graceful degradation mode, where the system tunes its performance to the remaining fabric capacity.

The advanced fabric architecture is complemented by comprehensive hardware redundancy for the management modules, power supplies, and cooling system. In addition, the Brocade Multi-Service IronWare operating system offers hitless management failover with Open Shortest Path First (OSPF), IS-IS and IP multicast Non-Stop Routing, and Border Gateway Protocol (BGP) graceful restart capabilities—as well as hitless (in-service) software upgrades to further enhance both system availability and overall network availability. To maintain continuous operations in data centers and metro networks, the innovative Brocade Multi-Chassis Trunking (MCT) feature provides fast link and node failover protection while simultaneously maximizing network utilization.

ADVANCED CAPABILITIES FOR A BROAD RANGE OF APPLICATIONS

The Brocade MLX Series provides a wide range of capabilities to support advanced applications and services in the most demanding network environments, both in service provider and data center environments.

The routers enable scalable and resilient Layer 2 Metro Ethernet services that comply with the Metro Ethernet Forum (MEF) specifications for Ethernet Private Line (EPL), Ethernet Virtual Private Line (EVPL), and Ethernet LAN (E-LAN). Complementing Layer 2 Metro Ethernet capabilities is a powerful suite of MPLS capabilities and services, including MPLS-TE, Fast ReRoute (FRR), MPLS Virtual Leased Line (VLL), Virtual Private LAN Service (VPLS), and BGP/MPLS VPNs (MPLS Layer 3 VPNs).

The combination of Layer 2/3 features and advanced MPLS capabilities enables the routers to function in the data center core and connect geographically distributed data centers using standards-based technology such as VPLS. Within the data center, advanced network resiliency features, such as MCT, eliminate the need for spanning tree while enabling efficient usage of network resources through active-active load balancing.

RICH QUALITY OF SERVICE FOR SERVICE LEVEL AGREEMENTS

Service provider business services are often tiered under different service levels, ranging from premium to “best-effort” services. At each level of service, providers must meet or exceed customer agreements—and failing to do so can lead to strict financial penalties and loss of business. As a result, Quality of Service (QoS) is a critical factor in creating selective services and meeting Service Level Agreements (SLAs).

A comprehensive suite of advanced traffic management and QoS functions enables the deployment of triple-play service provider networks and converged enterprise networks supporting voice, video, and data. The Brocade MLX Series offers advanced bandwidth control capabilities with two-rate, three-color traffic policers that provide committed bandwidth to users and/or applications. The routers also provide advanced packet marking, prioritization, queuing, and scheduling with Weighted Random Early Discard (WRED) congestion management for optimal and granular control of bandwidth utilization throughout the network.

SIMPLIFIED SERVICE MANAGEMENT

Delivering effective MPLS services on Carrier Ethernet infrastructure requires fast fault identification and isolation. The Brocade MLX Series supports MPLS Labeled Switch Path (LSP) ping and trace route features to isolate any MPLS-related connectivity issues. In addition, it supports all the capabilities of IEEE 802.1ag (Connectivity Fault Management), including Connectivity Check Messages, Loopback Message/Response, and LinkTrace Message/Response.

IEEE 802.1ag, in conjunction with the MPLS OAM features, provides the capabilities to monitor, isolate, and identify connectivity problems and reduce the time to repair business VPN services. For performance management on Carrier Ethernet infrastructure, the Brocade MLX Series supports Y.1731 to measure round-trip delay and jitter characteristics between two points in the network. To diagnose link layer connectivity issues, the routers also support the IEEE 802.3ah Link OAM feature.

In addition, the Brocade MLX Series supports standards-based sFlow traffic monitoring technology, which provides

unprecedented visibility into network usage. Integrated into the line module hardware, the sFlow technology enables the monitoring of high-speed links without impacting performance.

To simplify the manageability of Ethernet services, the Brocade MLX Series leverages Brocade Network Advisor, an application that unifies network management for all Brocade products. Brocade Network Advisor provides the easy-to-use MPLS Manager, which can help configure, monitor, and manage VPLS and Virtual Leased Line (VLL) services across networks that are based on Brocade routers. In addition, the sFlow-based technology utilized by Brocade Network Advisor reduces network downtime with proactive monitoring, traffic analysis, and reporting.

SOFTWARE-DEFINED NETWORKING

Software-Defined Networking (SDN) is a powerful new network paradigm designed for the world’s most demanding networking environments. The Brocade MLX Series enables SDN by supporting the OpenFlow protocol, which allows communication between an OpenFlow controller and an OpenFlow-enabled router. Using this approach, organizations can control their networks programmatically, transforming the network into a platform for innovation through new network applications and services.

ENABLING GREEN OPERATIONS

Although adding routers to address bandwidth shortage might initially solve the capacity problem, it does so at the expense of the environment and the opportunity to reduce energy and space costs. Any new solution that fails to reduce energy consumption is only a partial answer to the problem.

Each new generation of line modules on the Brocade MLX Series consumes less energy per bit than the previous generation while significantly increasing throughput per module. In addition, the routers provide industry-leading wire-speed port densities for 1 GbE, 10 GbE, and 100 GbE interfaces, efficiently consolidating more services and collapsing network layers.

For example, in data center environments, the Virtual Top of Rack (VToR) solution with the 48-T module on the Brocade MLX Series reduces the number of active power-consuming devices in the network—thereby providing significant savings on power, cooling, and overall operating expenditures.

BROCADE MLX SERIES LINE MODULES

The Brocade MLX Series provides a wide range of leading-edge Ethernet modules and traditional SONET line modules. The flexible half-slot 1 GbE, 10 GbE, and full-slot 100 GbE modules enable organizations to use a single platform for both low-speed and high-speed applications. These Ethernet line modules support advanced Layer 2/3 features and scalable MPLS features such as VPLS and Layer 3 VPNs—helping service providers to maximize their revenue opportunities and enterprises to design highly virtualized data centers.

The line modules include:

- 100 GbE modules
- 10 GbE modules (8- and 4-port models)
- 1 GbE modules (48- and 24-port models)
- SONET modules

100 GbE Module



The 2-port 100 GbE module provides unmatched performance and scalability up to 32 wire-speed 100 GbE ports in a single Brocade MLXe-32 router and 16 wire-speed 100 GbE ports in a single Brocade MLX-32 router. This full-slot module complies with the IEEE 802.3ba standard and supports CFP-based short-reach and long-reach optics. Each 2×100 GbE module delivers 400 Gbps of throughput per module without compromising the performance of features such as IPv4, IPv6, and MPLS.

Service providers that want to scale beyond 100 GbE can utilize the industry's only multi-terabit trunks—a single logical connection formed by aggregating multiple 100 GbE ports—to achieve superior scalability and performance for Internet backbones. For network planners following a pay-as-you-grow strategy, the 2×100 GbE module supports an innovative “Ports on Demand” feature that non-disruptively enables the second port via a software license.

10 GbE Modules

10 GbE modules for the Brocade MLX Series are available in 8-port and 4-port models.

8-Port 10 GbE Module



The half-slot 8-port 10 GbE module provides the highest 10 GbE port density in a single router. This module is available in three versions: the 8×10 GbE-X, the 8×10 GbE-M, and the 8×10 GbE-D. All support wire-speed performance on all ports simultaneously, irrespective of the service deployed. The 8×10 GbE module supports hot-swappable SFP+ optical transmitters with software-configurable LAN PHY and WAN PHY modes.

The 8×10 GbE-X module has a FIB size of one million entries and supports full Layer 2/IPv4/IPv6 functionality with advanced features such as MPLS, VPLS, and QinQ. This module is ideal for service provider core applications.

The 8×10 GbE-M module has a FIB size of 512,000 entries and supports full Layer 2/IPv4/IPv6 functionality with advanced features such as MPLS, VPLS, and QinQ. This module is ideal for metro aggregation and transit networks that require advanced Layer 2 and MPLS services as well as greater scalability.

The 8×10 GbE-D module supports Layer 2/IPv4/IPv6 functionality with a FIB capacity of up to 256,000 IPv4 routes. It is ideal for network providers and data centers that need a Layer 2/3 architecture with Layer 2 and IP services.



4-Port 10 GbE Module

This half-slot module supports Layer 2 and advanced MPLS features, enabling network planners to follow a pay-as-you-grow model. The 4×10 GbE module is available in two versions, one with a FIB capacity of 512,000 routes and the other with 1 million entries. The 4×10 GbE module supports hot-swappable XFP optical transmitters with software-configurable LAN PHY and WAN PHY modes.

1 GbE Modules

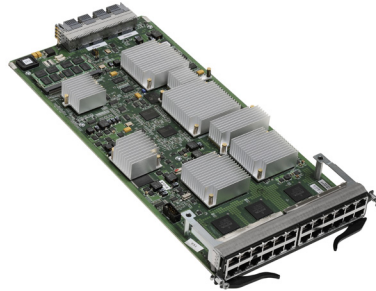
1 GbE modules for the Brocade MLX Series are available in 48- and 24-port models.

48-Port 1 GbE Module



This auto-sensing tri-speed (10/100/1000 Mbps) module incorporates a space-saving design with mini-RJ21 connectors. It supports wire-speed performance of IPv4 and advanced MPLS features, and enables

massive consolidation with 1536 GbE ports in a single chassis. In data center environments the 48-T module, along with the MRJ-21 patch panel, allows direct connection from the server to the Brocade MLX Series, reducing cabling complexity, latency, and management overhead.



24-Port 1 GbE Module

This half-slot module, available in RJ45 copper and SFP versions, is ideal for environments that need to aggregate multiple 1 GbE fiber links. It supports full Layer 2/IPv4/IPv6 functionalities while supporting advanced features such as MPLS, VPLS, and QinQ. In addition, the 24×1 GbE module has a FIB capacity of 512,000 routes and a built-in upgrade path to scale to 1 million entries.

SONET Modules

The Brocade MLX Series provides native POS interfaces with speeds ranging from OC-12 (STM-4) to OC-192 (STM-64), enabling native connectivity to SONET/SDH optical transport equipment or to existing POS routers at distances up to 80 kilometers. The routers offer superior interface density with 64 POS-OC192c/STM-64c per system and 256 POS OC-48c/STM-16c or POS OC-12c/STM-4c per system.

BROCADE GLOBAL SERVICES

Brocade Global Services has the expertise to help organizations build scalable, efficient cloud infrastructures. Leveraging 15 years of expertise in storage, networking, and virtualization, Brocade Global Services delivers world-class professional services, technical support, network monitoring services, and education, enabling organizations to maximize their Brocade investments, accelerate new technology deployments, and optimize the performance of networking infrastructures.

CLOUD-OPTIMIZED NETWORK ACQUISITION

Brocade helps organizations easily address their information technology requirements by offering flexible network acquisition and support alternatives to meet their financial needs. Organizations can select from purchase, lease, and Brocade Network Subscription options to align network acquisition with their unique capital requirements and risk profiles.

MAXIMIZING INVESTMENTS

To help optimize technology investments, Brocade and its partners offer complete solutions that include professional services, technical support, and education. For more information, contact a Brocade sales partner or visit www.brocade.com.

KEY FEATURES

Service provider-grade metro routers with IPv4/IPv6/MPLS/
Multi-VRF enabled

4-, 8-, 16-, and 32-slot systems for maximum deployment
versatility

Up to 4.8 billion packets per second routing performance
with non-blocking 6.4 Tbps data capacity

Ideal for demanding, high-density environments:

- 32 100 GbE ports per system
- 256 10 GbE and 1536 1 GbE ports per system
- 64 OC-192/256 OC-48 ports per system

Advanced and scalable Metro Ethernet Layer 2 services:

- Super aggregated VLANs (QinQ)
- Comprehensive set of Layer 2 control protocols:
MRP, VSRP, RSTP, MSTP
- IEEE 802.1ad Provider Bridges
- Provider Backbone Bridging
- Extended statistics, including per-port per-VLAN per priority
counters for VPLS and VLL endpoints

MEF 9 and MEF 14 certification for Carrier Ethernet services

Industry-leading 640 Gbps link aggregation capability for
aggregating up to 64 10 GbE/OC-192 links in provider
backbones

Support for fate sharing of link groups and bypass LSPs for
increased resiliency

Wire-speed, dual-stack IPv4/IPv6 routing

Wire-speed Provider Edge (PE) and Provider core (P) Label
Switching Routers

Industry-leading performance for MPLS services, providing
several service choices: IPv6 over MPLS (6PE), MPLS over
GRE, Virtual Leased Line (VLL), Virtual Private LAN Service
(VPLS), BGP/MPLS VPN, Multi-VRF, and routing over VPLS

High-performance, robust routing via Brocade Direct
Routing (BDR) for complete, distributed programming of the
Forwarding Information Base (FIB) in hardware

Full suite of unicast and multicast IPv4 and IPv6 routing
protocols:

- Supported IPv4 protocols include RIP, OSPF, BGP-4, IS-IS, PIM-DM,
PIM-SM/SSM, IGMP, BGP-MP for multicast, MSDP, and Anycast RP
- Supported IPv6 protocols include RIPng, OSPFv3, IS-IS for IPv6,
BGP-MP for IPv6 (BGP4+), PIM-SM/SSM, MLD, VRRPv6, and IPv6
Non-Stop Routing (NSR)

Comprehensive MPLS signaling and path calculation
algorithms for both traffic-engineered and non-traffic-
engineered applications:

- OSPF-TE, IS-IS-TE, RSVP-TE, CSPF, LDP over RSVP
- MPLS FRR (detour, bypass) and hot standby paths for traffic
protection
- LDP

Secure Multi-VRF routing to support Virtual Routing applications
over non-MPLS backbones; supports both IPv4 and IPv6 Multi-VRFs

Industry-leading scalability up to:*

- 10 million BGP routes
- 1 million IPv4 routes in hardware (FIB)
- 240,000 IPv6 routes in hardware (FIB)
- 2000 BGP peers per system
- 2000 BGP/MPLS VPNs and up to 1 million VPN routes
- 48,000 VLLs per system
- 16,000 VPLS instances and up to 1 million VPLS MAC addresses
- 64,000 RSVP-TE LSPs
- 4094 VLANs and up to 2 million MAC addresses
- 8-path Equal Cost MultiPath (ECMP)

Superior high-availability design:

- Redundant management modules
- Redundant switch fabrics
- Redundant power supplies and cooling system
- Hitless Layer 2/3 failover with stateful OSPF and IS-IS redundancy,
and BGP graceful restart
- Hitless (in-service) software upgrades with graceful restart

Advanced QoS:

- Hierarchical Quality of Service (H-QoS) for 8×10 GbE
(M and X) modules
- Inbound and outbound two-rate three-color traffic policers
with accounting
- Eight distinct priority levels
- WRED support for congestion management and precedence
dropping (tunable via configuration)
- Support for hybrid queue servicing disciplines: Mixed, Strict
Priority, and Weighted Fair Queuing

Comprehensive hardware-based security and policies:

- Layer 2/3 ACLs (both inbound and outbound)
- Granular ACL accounting (both inbound and outbound)
- Hardware-based packet filtering
- Hardware-based Policy-Based Routing (PBR)
- Unicast Reverse Path Forwarding (uRPF)
- Receive ACLs
- Extensive sFlow Layer 2-7 traffic monitoring for IPv4, IPv6, and
MPLS services

Combined Carrier Ethernet and powerful Packet
over SONET/SDH:

- MEF 9 and MEF 14 certification for Carrier Ethernet services
- Flexible set of POS interfaces with carrier-class timing offering
internal stratum 3, loop, line, and BITS timing support

Software-Defined Networking (SDN):

- Support for OpenFlow v1.0

* Scalability limits depend on configured system parameters,
NetIron XMR module types, licenses, system profile selected,
and routing database complexity.

BROCADE MLX SERIES AT A GLANCE

| Features | MLXe-4 | MLX-4 | MLXe-8 | MLX-8 | MLXe-16 | MLX-16 | MLXe-32 | MLX-32 |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Interface slots | 4 | 4 | 8 | 8 | 16 | 16 | 32 | 32 |
| Switch fabric capacity | 1.92 Tbps | 960 Gbps | 3.84 Tbps | 1.92 Tbps | 7.68 Tbps | 3.84 Tbps | 15.36 Tbps | 7.68 Tbps |
| Data forwarding capacity | 800 Gbps | 640 Gbps | 1.6 Tbps | 1.28 Tbps | 3.2 Tbps | 2.56 Tbps | 6.4 Tbps | 5.12 Tbps |
| Packet routing performance | 600 million pps | 480 million pps | 1.2 billion pps | 960 million pps | 2.4 billion pps | 1.9 billion pps | 4.8 billion pps | 3.8 billion pps |
| Maximum 100 GbE ports | 4 | 2 | 8 | 4 | 16 | 8 | 32 | 16 |
| Maximum 10 GbE ports | 32 | 32 | 64 | 64 | 128 | 128 | 256 | 256 |
| Maximum 1 GbE ports | 192 | 192 | 384 | 384 | 768 | 768 | 1536 | 1536 |
| Maximum OC-192 (STM-64) ports | 8 | 8 | 16 | 16 | 32 | 32 | 64 | 64 |
| Maximum OC-48 (STM-16) ports | 32 | 32 | 64 | 64 | 128 | 128 | 256 | 256 |
| Height (inches/rack units) | 8.71 in./ 5RU | 6.96 in./ 4RU | 12.21 in./ 7RU | 12.21 in./ 7RU | 24.50 in./ 14RU | 24.47 in./ 14RU | 57.75 in./ 33RU | 57.71 in./ 33RU |
| Power supply redundancy | M+N | M+N | M+N | M+N | M+N | M+N | M+N | M+N |
| Airflow | Side to back | Side to side | Side to back | Side to side | Front to back | Front to back | Front to back | Front to back |

BROCADE MLX SERIES POWER SPECIFICATIONS

| | MLXe-4 | MLX-4 | MLXe-8 | MLX-8 | MLXe-16 | MLX-16 | MLXe-32 | MLX-32 |
|--|--------|-------|--------|-------|---------|--------|---------|--------|
| Maximum DC power consumption (W) | 1730 | 1389 | 3356 | 2760 | 5698 | 5591 | 11,414 | 11,391 |
| Maximum AC power consumption (W) (100-240 VAC) | 1730 | 1389 | 3356 | 2760 | 5698 | 5591 | 11,414 | 11,391 |
| Maximum thermal output (BTU/HR) | 5905 | 4740 | 11,453 | 9419 | 19,446 | 19,081 | 38,958 | 38,876 |

Note: The routers require more power when fully loaded with NI-MLX-1Gx48-T-A, BR-MLX-10Gx8-X, or 100 GbE modules.

BROCADE MLX SERIES PHYSICAL SPECIFICATIONS

| Model | Dimensions | Weight |
|-----------------|--|-------------------------------|
| Brocade MLXe-4 | 17.20 in. W × 8.71 in. H × 23.0 in. D (43.69 cm × 22.12 cm × 58.42 cm) | 117 lb (53 kg) |
| Brocade MLXe-8 | 17.20 in. W × 12.21 in. H × 24.0 in. D (43.69 cm × 31.01 cm × 60.96 cm) | 171 lb (78 kg) |
| Brocade MLXe-16 | 17.20 in. W × 24.47 in. H × 24.18 in. D (43.69 cm × 62.15 cm × 61.42 cm) | 351 lb (159 kg) |
| Brocade MLXe-32 | 17.45 in. W × 57.75 in. H × 26.88 in. D (44.32 cm × 146.69 cm × 68.28 cm) | 505 lb (229 kg) |
| Brocade MLX-4 | 17.45 in. W × 6.96 in. H × 22.5 in. D (44.32 cm × 17.68 cm × 57.15 cm) | 78 lb (35 kg) |
| Brocade MLX-8 | 17.45 in. W × 12.21 in. H × 22.5 in. D (44.32 cm × 31.01 cm × 57.15 cm) | 131 lb (60 kg) |
| Brocade MLX-16 | 17.45 in. W × 24.47 in. H × 25.5 in. D (44.32 cm × 62.15 cm × 64.77 cm) | 236 lb (107 kg) |
| Brocade MLX-32 | 17.45 in. W × 57.71 in. H × 24.1 in. D (44.32 cm × 146.58 cm × 61.21 cm) | Approximately 478 lb (217 kg) |

BROCADE MLX SERIES SPECIFICATIONS

IEEE Compliance

- 802.3-2005 CSMA/CD Access Method and Physical Layer Specifications
- 802.3ab 1000BASE-T
- 802.3ae 10 Gigabit Ethernet
- 802.3x Flow Control
- 802.3ad Link Aggregation
- 802.3ah Ethernet in the First Mile
- 802.1Q Virtual Bridged LANs
- 802.1D MAC Bridges
- 802.1w Rapid STP
- 802.1s Multiple Spanning Trees
- 802.1ad Provider Bridges; partial support: port-based and S-tagged service interface
- 802.1ag Connectivity Fault Management (CFM)
- 8023.ba 100 Gigabit Ethernet
- 802.1ab Link Layer Discovery Protocol
- 802.1ah Provider Backbone Bridging

ITU Compliance

- Y.1731 OAM functions and mechanisms for Ethernet-based networks

RFC Compliance

| | |
|-------|---|
| BGPv4 | <ul style="list-style-type: none">• RFC 4271 BGPv4• RFC 1745 OSPF Interactions• RFC 1997 Communities and Attributes• RFC 2439 Route Flap Dampening• RFC 2796 Route Reflection• RFC 1965 BGP4 Confederations• RFC 2842 Capability Advertisement• RFC 2918 Route Refresh Capability• RFC 1269 Managed Objects for BGP• RFC 2385 BGP Session Protection via TCP MD5• RFC 3682 Generalized TTL Security Mechanism, for eBGP Session Protection• RFC 4273 BGP-4 MIB• RFC 4893 BGP Support for Four-octet AS Number Space• RFC 4724 Graceful Restart Mechanism for BGP |
| OSPF | <ul style="list-style-type: none">• RFC 2328 OSPF v2• RFC 3101 OSPF NSSA• RFC 1745 OSPF Interactions• RFC 1765 OSPF Database Overflow• RFC 1850 OSPF v2 MIB• RFC 2370 OSPF Opaque LSA Option• RFC 3630 TE Extensions to OSPF v2• RFC 3623 Graceful OSPF Restart |

| | |
|-------------------|---|
| IS-IS | <ul style="list-style-type: none">• RFC 1195 Routing in TCP/IP and Dual Environments• RFC 1142 OSI IS-IS Intra-domain Routing Protocol• RFC 2763 Dynamic Host Name Exchange• RFC 2966 Domain-wide Prefix Distribution• RFC 5120 IS-IS Multi-Topology Support |
| RIP | <ul style="list-style-type: none">• RFC 1058 RIP v1• RFC 2453 RIP v2• RFC 1812 RIP Requirements |
| • IPv4 Multicast | <ul style="list-style-type: none">• RFC 1122 Host Extensions• RFC 1112 IGMP• RFC 2236 IGMP v2• RFC 3376 IGMP v3• RFC 3973 PIM-DM• RFC 2362 PIM-SM• RFC 2858 BGP-MP• RFC 3618 MSDP• RFC 3446 Anycast RP• RFC 5905 Network Time Protocol |
| General Protocols | <ul style="list-style-type: none">• RFC 791 IP• RFC 792 ICMP• RFC 793 TCP• RFC 1350 TFTP• RFC 826 ARP• RFC 768 UDP• RFC 894 IP over Ethernet• RFC 903 RARP• RFC 906 TFTP Bootstrap• RFC 1027 Proxy ARP• RFC 951 BootP• RFC 1122 Host Extensions for IP Multicasting• RFC 1256 IRDP• RFC 1519 CIDR• RFC 1542 BootP Extensions• RFC 1812 Requirements for IPv4 Routers• RFC 1541 and 1542 DHCP• RFC 2131 BootP/DHCP Helper• RFC 3768 VRRP• RFC 854 TELNET• RFC 1591 DNS (client)• RFC 5905 Network Time Protocol |

BROCADE MLX SERIES SPECIFICATIONS (CONTINUED)

| RFC Compliance (continued) | |
|----------------------------|--|
| QoS | <ul style="list-style-type: none"> • RFC 2475 An Architecture for Differentiated Services • RFC 3246 An Expedited Forwarding PHB • RFC 2597 Assured Forwarding PHB Group • RFC 2698 A Two-Rate Three-Color Marker |
| Other | <ul style="list-style-type: none"> • RFC 1354 IP Forwarding MIB • RFC 2665 Ethernet Interface MIB • RFC 1757 RMON Groups 1, 2, 3, 9 • RFC 2068 HTTP • RFC 4330 SNMP • RFC 2865 RADIUS • RFC 3176 sFlow • RFC 2863 Interfaces Group MIB • Draft-ietf-tcpm-tcpsecure TCP Security • RFC 3704 Ingress Filtering for Multihomed Networks (uRPF) • RFC 2784 Generic Routing Encapsulation (GRE) • draft-ietf-bfd-base Bidirectional Forwarding Detection (BFD) • RFC 5881, BFD for IPv4 and IPv6 (Single Hop); for OSPFv2 • OSPFv3, IS-IS • RFC 4741 NETCONF (Partial) • RFC 4087 IP Tunnel MIB |
| IPv6 Core | <ul style="list-style-type: none"> • RFC 2460 IPv6 Specification • RFC 2461 IPv6 Neighbor Discovery • RFC 2462 IPv6 Stateless Address Auto-configuration • RFC 4443 ICMPv6 • RFC 4291 IPv6 Addressing Architecture • RFC 3587 IPv6 Global Unicast Address Format • RFC 2375 IPv6 Multicast Address Assignments • RFC 2464 Transmission of IPv6 over Ethernet Networks • RFC 2711 IPv6 Router Alert Option • RFC 3596 DNS support • RFC 3315 Dynamic Host Configuration Protocol (DHCP) for IPv6 |
| IPv6 Routing | <ul style="list-style-type: none"> • RFC 2080 RIPng for IPv6 • RFC 2740 OSPFv3 for IPv6 • draft-ietf-isis-ipv6 Routing IPv6 with IS-IS • RFC 2545 Use of BGP-MP for IPv6 |
| IPv6 Multicast | <ul style="list-style-type: none"> • RFC 2710 Multicast Listener Discovery (MLD) for IPv6 • RFC 3810 Multicast Listener Discovery Version 2 for IPv6 • RFC 4604 IGMPv3 and MLDv2 for SSM • RFC 4607 Source-Specific Multicast for IP • RFC 2362 PIM-SM • draft-ietf-pim-sm-v2-new; partial support: SSM mode of operation |
| IPv6 Transitioning | <ul style="list-style-type: none"> • RFC 2893 Transition Mechanisms for IPv6 Hosts and Routers • RFC 3056 Connection of IPv6 Domains via IPv4 Clouds • RFC 4798 Connecting IPv6 Islands over IPv4 MPLS Using IPv6 Provider Edge Routers |
| MPLS | <ul style="list-style-type: none"> • RFC 3031 MPLS Architecture • RFC 3032 MPLS Label Stack Encoding • RFC 3036 LDP Specification • RFC 2205 RSVP v1 Functional Specification • RFC 2209 RSVP v1 Message Processing Rules • RFC 3209 RSVP-TE • RFC 3270 MPLS Support of Differentiated Services • RFC 4090 Fast Reroute Extensions to RSVP-TE for LSP Tunnels • RFC 3812 MPLS TE MIB • RFC 5443 LDP IGP Synchronization • RFC 5712 MPLS Traffic Engineering Soft Preemption • draft-ietf-bfd-mpls BFD for MPLS LSPs (RSVP-TE) |
| Layer 3 VPN | <ul style="list-style-type: none"> • RFC 2858 Multiprotocol Extensions for BGP-4 • RFC 3107 Carrying Label Information in BGP-4 • RFC 4364 BGP/MPLS IP VPNs • draft-ietf-idr-bgp-ext-communities BGP Extended Communities Attribute • RFC 4576 Using LSA Options Bit to Prevent Looping in BGP/MPLS IP VPNs (DN Bit) • RFC 4577 OSPF as the PE/CE Protocol in BGP/MPLS IP VPNs • draft-ietf-idr-route-filter Cooperative Route Filtering Capability for BGP-4 • RFC 4382 MPLS/BGP Layer 3 VPN MIB |
| Layer 2 VPN and PWE3 | <ul style="list-style-type: none"> • RFC 4664 Framework for Layer 2 Virtual Private Networks • RFC 4665 Service Requirements for Layer 2 Provider-Provisioned Virtual Private Networks • RFC 4762 VPLS Using LDP Signaling • draft-ietf-pwe3-arch PWE3 Architecture • RFC 4447 Pseudowire Setup and Maintenance using LDP • RFC 4448 Encapsulation Methods for Transport of Ethernet over MPLS Networks • RFC 5542 Definitions of Textual Conventions for Pseudowire (PW) Management • RFC 5601 Pseudowire (PW) Management Information Base |

Packet Over SONET/SDH

- RFC 1661 The Point-to-Point Protocol (PPP)
- RFC 1662 PPP in HDLC-like Framing
- RFC 2615 PPP over SONET/SDH
- RFC 1332 Internet Protocol Control Protocol (IPCP)
- RFC 1377 The PPP OSI Network Layer Control Protocol (OSINLCP)
- RFC 2472 IPv6 over PPP
- RFC 3592 SONET/SDH Objects
- GR-253-CORE SONET Transport Systems: Common Generic Criteria
- G.707/Y.1322 Network Node Interface for SDH

MEF Certification

- MEF 9 Certified—Abstract Test Suite for Ethernet Services at the UNI
- MEF 14 Certified—Abstract Test Suite for Traffic Management Phase 1

Network Management

- Brocade Network Advisor Web-based Graphical User Interface (GUI)
- Integrated industry-standard Command Line Interface (CLI)
- sFlow (RFC 3176)
- Telnet
- SNMP v1, v2c, v3
- SNMP MIB II
- RMON
- Support for automated configuration management using NETCONF

Element Security Options

- AAA
- RADIUS
- Secure Shell (SSH v2)
- Secure Copy (SCP v2)
- HTTPs
- TACACS/TACACS+
- Username/Password (Challenge and Response)
- Bi-level Access Mode (Standard and EXEC Level)
- Protection against Denial of Service (DoS) attacks, such as TCP SYN or Smurf Attacks

Environmental

- Operating temperature: 0 °C to 40 °C (32 °F to 104 °F)
- Storage temperature: -25 °C to 70 °C (-13 °F to 158 °F)
- Relative humidity: 5% to 90%, at 40 °C (104 °F), non-condensing
- Storage humidity: 95% maximum relative humidity, non-condensing
- Operating altitude: 6600 ft (2012 m)
- Storage altitude: 15,000 ft (4500 m) maximum

Safety Agency Approvals

- CAN/CSA-C22.2 No. 60950-1-3
- UL 60950-1
- IEC 60950-1
- EN 60950-1 Safety of Information Technology Equipment
- EN 60825-1 Safety of Laser Products—Part 1: Equipment Classification, Requirements and User's Guide
- EN 60825-2 Safety of Laser Product—Part 2: Safety of Optical Fibre Communication Systems

Electromagnetic Emission

- ICES-003 Electromagnetic Emission
- FCC Class A
- EN 55022/CISPR-22 Class A/VCCI Class A
- AS/NZS 55022
- EN 61000-3-2 Power Line Harmonics
- EN 61000-3-3 Voltage Fluctuation and Flicker
- EN 61000-6-3 Emission Standard (supersedes EN 50081-1)

Immunity

- EN 61000-6-1 Generic Immunity and Susceptibility (supersedes EN 50082-1)
- EN 55024 Immunity Characteristics. Supersedes:
 - EN 61000-4-2 ESD
 - EN 61000-4-3 Radiated, radio frequency, electromagnetic field
 - EN 61000-4-4 Electrical fast transient
 - EN 61000-4-5 Surge
 - EN 61000-4-6 Conducted disturbances induced by radio-frequency fields
 - EN 61000-4-8 Power frequency magnetic field
 - EN 61000-4-11 Voltage dips and sags

TELCO NEBS/ETSI

Designed to meet the following specifications (formal testing under way):

- Telcordia GR-63-CORE NEBS Requirements: Physical Protection
- Telcordia GR-1089-CORE EMC and Electrical Safety
- Telcordia SR-3580 Level 3
- ETSI ETS 300-019 Physical Protection
 - Part 1-1, Class 1.1, Partly Temperature Controlled Storage Locations
 - Part 1-2, Class 2.3, Public Transportation
 - Part 1-3, Class 3.1, Temperature Controlled Locations (Operational)
- ETSI ETS 300-386 EMI/EMC

Power and Grounding

- ETS 300 132-1 Equipment Requirements for AC Power Equipment Derived from DC Sources
- ETS 300 132-2 Equipment Requirements for DC Powered Equipment
- ETS 300 253 Facility Requirements

Physical Design and Mounting

19-inch rack mount supporting racks compliant with:

- ANSI/EIA-310-D
- ETS 300 119
- GR-63-CORE Seismic Zone 4 Table top

Environmental Regulatory Compliance

- EU 2002/95/EC RoHS (with lead exemption)
- EU 2002/96/EC WEEE

Network Equipment Building Standards (NEBS)

- GR-1089-CORE NEBS EMC and Safety
- GR-63 CORE: NEBS Physical Protection
- SR-3580: NEBS Criteria Levels (Level 3)

BROCADE MLX SERIES ORDERING INFORMATION

| Part Number | Description |
|---------------------|---|
| BR-MLXE-4-AC | 4-slot Brocade MLXe-4 AC system |
| NI-MLX-4-AC | 4-slot Brocade MLX-4 AC system |
| BR-MLXE-8-AC | 8-slot Brocade MLXe-8 AC system |
| NI-MLX-8-AC | 8-slot Brocade MLX-8 AC system |
| BR-MLXE-16-AC | 16-slot Brocade MLXe-16 AC system |
| NI-MLX-16-AC | 16-slot Brocade MLX-16 AC system |
| BR-MLXE-32-AC | 32-slot Brocade MLXe-32 AC system |
| NI-MLX-32-AC | 32-slot Brocade MLX-32 AC system |
| BR-MLXE-4-DC | 4-slot Brocade MLXe-4 DC system |
| NI-MLX-4-DC | 4-slot Brocade MLX-4 DC system |
| BR-MLXE-8-DC | 8-slot Brocade MLXe-8 DC system |
| NI-MLX-8-DC | 8-slot Brocade MLX-8 DC system |
| BR-MLXE-16-DC | 16-slot Brocade MLXe-16 DC system |
| NI-MLX-16-DC | 16-slot Brocade MLX-16 DC system |
| BR-MLXE-32-DC | 32-slot Brocade MLXe-32 DC system |
| NI-MLX-32-DC | 32-slot Brocade MLX-32 DC system |
| BR-MLX-MR2-M | Brocade MLX system management module, 4 GB SDRAM, 2 GB internal compact flash, external compact flash slot, EIA/TIA-232 and 10/100/1000 Ethernet ports for out-of-band management |
| BR-MLX-MR2-X | Brocade MLXe system management module, 4 GB SDRAM, 2 GB internal compact flash, external compact flash slot, EIA/TIA-232 and 10/100/1000 Ethernet ports for out-of-band management |
| BR-MLX-32-MR2-M | Brocade MLX 32-slot system management module, 4 GB SDRAM, 2 GB internal compact flash, external compact flash slot, EIA/TIA-232 and 10/100/1000 Ethernet ports for out-of-band management |
| BR-MLX-32-MR2-X | Brocade MLXe 32-slot system management module, 4 GB SDRAM, 2 GB internal compact flash, external compact flash slot, EIA/TIA-232 and 10/100/1000 Ethernet ports for out-of-band management |
| NI-MLX-MR | Brocade MLX system management module, 1 GB SDRAM, dual PCMCIA slots, EIA/TIA-232, and 10/100/1000 Ethernet ports for out-of-band management |
| NI-MLX-32-MR | Brocade MLX-32 system management module, 1 GB SDRAM, dual PCMCIA slots, EIA/TIA-232, and 10/100/1000 Ethernet ports for out-of-band management |
| NI-XMR-MR | Netron XMR system management module, 2 GB SDRAM, dual PCMCIA slots, EIA/TIA-232, and 10/100/1000 Ethernet ports for out-of-band management for Brocade MLXe |
| NI-XMR-32-MR | Netron XMR system management module, 2 GB SDRAM, dual PCMCIA slots, EIA/TIA-232, and 10/100/1000 Ethernet ports for out-of-band management for Brocade MLXe |
| NI-X-4-HSF | Brocade MLX 4-slot system high-speed switch fabric module |
| NI-X-16-8-HSF | Brocade MLX 8/16-slot system high-speed switch fabric module |
| NI-X-32-HSF | Brocade MLX 32-slot system high-speed switch fabric module |
| BR-MLX-100Gx2-X | Brocade MLX Series 2-port 100 GbE module with IPv4/IPv6/MPLS hardware support—requires high-speed switch fabric modules and CFP optics |
| BR-MLX-100Gx1-X | Brocade MLX Series 1-port 100 GbE module with IPv4/IPv6/MPLS hardware support—requires high-speed switch fabric modules and CFP optics |
| BR-MLX-100Gx1-2PUPG | Brocade MLX Series 100 GbE second port license—requires CFP optics |
| BR-MLX-10Gx8-X | Brocade MLX Series 8-port 10 GbE (X) module with IPv4/IPv6/MPLS hardware support—requires SFP optics. Supports up to 1 million IPv4 routes in FIB. Requires high-speed switch fabric modules. |
| NI-MLX-10Gx8-M | Brocade MLX Series 8-port 10 GbE (M) module with IPv4/IPv6/MPLS hardware support and up to 512,000 IPv4 routes—requires SFP+ optics and high-speed switch fabric modules |
| NI-MLX-10Gx8-D | Brocade MLX Series 8-port 10 GbE (D) module with IPv4/IPv6 hardware support and up to 256,000 IPv4 routes — requires SFP+ optics and high-speed switch fabric modules |

BROCADE MLX SERIES ORDERING INFORMATION (CONTINUED)

| | |
|--------------------|---|
| BR-MLX-10Gx4-X | Brocade MLX Series 4-port 10 GbE (X) module with IPv4/IPv6/MPLS hardware support—requires XFP optics. Supports 1 million IPv4 routes in FIB. |
| NI-MLX-10Gx4 | Brocade MLX Series 4-port 10 GbE module with IPv4/IPv6/MPLS hardware support—requires XFP optics |
| NI-XMR-10Gx4 | NetIron XMR Series 4-port 10 GbE module with IPv4/IPv6/MPLS hardware support for Brocade MLXe—requires XFP optics |
| NI-MLX-10Gx2 | Brocade MLX Series 2-port 10 GbE module with IPv4/IPv6/MPLS hardware support—requires XFP optics |
| NI-XMR-10Gx2 | NetIron XMR Series 2-port 10 GbE module with IPv4/IPv6/MPLS hardware support for Brocade MLXe—requires XFP optics |
| NI-MLX-48-T-A | Brocade MLX Series 48-port 10/100/1000Base-T, MRJ21 module with IPv4/IPv6/MPLS hardware support |
| BR-MLX-1GFX24-X | Brocade MLX Series 24-port FE/GbE (SFP) module, with IPv4/IPv6/MPLS hardware support. Supports 1 million IPv4 routes in FIB. |
| BR-MLX-1GFX24-X-ML | Brocade MLX Series 24-port FE/GbE (SFP) module, with IPv4/IPv6/MPLS hardware support. Supports 512,000 IPv4 routes in FIB. License upgradable to “X” scalability (1 million IPv4 routes in FIB). |
| BR-MLX-1GXC24-X | Brocade MLX 24-port (X) 10/100/1000 copper (RJ-45) module, with IPv4/IPv6/MPLS hardware support. Supports 1 million IPv4 routes in FIB. |
| BR-MLX-1GXC24-X-ML | Brocade MLX 24-port (X) 10/100/1000 copper (RJ-45) module, with IPv4/IPv6/MPLS hardware support. Supports 512,000 IPv4 routes in FIB. License upgradable to “X” scalability (1 million IPv4 routes in FIB). |
| NI-MLX-1Gx20-SFP | Brocade MLX Series 20-port FE/GbE (100/1000) module with IPv4/IPv6/MPLS hardware support—requires SFP optics |
| NI-XMR-1Gx20-SFP | NetIron XMR Series 20-port FE/GbE (100/1000) module with IPv4/IPv6/MPLS hardware support for Brocade MLXe—requires SFP optics |
| NI-MLX-1Gx20-GC | Brocade MLX Series 20-port 10/100/1000 copper module with IPv4/IPv6/MPLS hardware support |
| NI-XMR-1Gx20-GC | NetIron XMR Series 20-port 10/100/1000 copper module with IPv4/IPv6/MPLS hardware support for Brocade MLXe |
| NI-X-OC192x2 | NetIron XMR 2-port Packet over SONET (SDH) OC-192 (STM-64) interface module for Brocade MLXe |
| NI-X-OC48x8 | NetIron XMR 8-port Packet over SONET (SDH) OC-12/48 (STM-4/16) interface module for Brocade MLXe |
| NI-X-OC48x4 | NetIron XMR 4-port Packet over SONET (SDH) OC-12/48 (STM-4/16) interface module for Brocade MLXe |
| NI-X-OC48x2 | NetIron XMR 2-port Packet over SONET (SDH) OC-12/48 (STM-4/16) interface module for Brocade MLXe |

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